

# Vital Pulp Therapy of Reversible Pulpitis with Chemical - Mechanical Excavation

Janet Kirilova

Associate Professor, Department of Conservative Dentistry, Faculty of Dental Medicine, Medical University, Sofia, Bulgaria

Tel: +359 888343396

Email: janetkirilova[at]gmail.com

**Abstract:** ***Aim:** The present paper aims to investigate direct pulp capping in treating Pulpitis Chronica Ulcerosa Incipiens by removing infected dentin with Brix 3000 (based on the enzyme papain), the treatment of dentin with gaseous ozone, and Biodentin has been applied as a pulp capping agent. **Material and Methods:** Patient PP (39 years old) was diagnosed with Pulpitis chronica ulcerosa incipient of tooth 45. The infected dentin was removed with Brix 3000<sup>[at]</sup> consist enzyme papain. The dentin was treated with gaseous ozone application for 24 seconds. Calcium silicate cement was put on the pulp communication. **Results:** After six months was shown preservation of tooth vitality. **Conclusion:** Within the follow - up of this clinical case, we found that using preparation based on the papain enzyme was conducive to preserving the vitality of the dental pulp under direct pulp capping. We combined it with the treatment of the dentine wound with gaseous ozone and calcium - silicate cement. Further studies are needed along these lines.*

**Keywords:** regenerative dental medicine; direct pulp capping; ozone therapy; chemico - mechanical excavation; BRIX 3000<sup>[at]</sup>

## 1. Introduction

Research in recent years has shown the regenerative potential of the dental pulp. Regenerative dentistry with a direction of vital pulp therapy is developing [1]. The latter includes indirect, direct pulp capping and pulpotomy [2]. Indications for direct pulp capping are reversible pulpitis. This includes diagnoses such as Collision pulpae in treating deep caries; initial stages of Pulpitis chronica ulcerosa [3, 4]. Direct pulp capping is a procedure in which the pulp is coated with material placed directly on the site of communication with it [5, 6].

The classic method involves cleaning the pulp wound from debris and blood to avoid the formation of a blood clot. Then, sterile swabs soaked with 17% EDTA are placed in the cavity. Another method of disinfection and stopping bleeding may be used, e. g., gaseous ozone [3, 7]. After carefully drying the cavity, a pulp capping agent (calcium silicate or glass - ionomer cement) is placed without pressure. Depending on the selected type of calcium silicate cement, a base and final restoration in one or two visits follow [3, 5]. Elect pulp, and thermal tests recommend check - ups after one week, six months, and 12 months [5].

As pulp capping agents, calcium silicate cement and glass - ionomer cement are recommended. For direct pulp capping, calcium - hydroxide cement [3] is not recommended.

The factors that influence the success of direct coverage are the size and localization of pulp communication; the patient's age; choice of the technique of work; integrity of the permanent restoration [5].

Stages of the healing process include surface necrosis and infiltration of inflammatory cells. Blood clots are resorbed, and the tissue is in the background of reorganization. The inflammatory reaction decreases, and a collagen - rich matrix is formed—amorphous tissue mineralization [1].

For the removal of infected dentin, the chemical - mechanical removal with Carisolv and its derivatives can be applied [2, 8]. The use of the routine technique of removal with rotary instruments has several disadvantages, such as the possibility of overheating of dentin; dehydration of dentin; exerting pressure and vibration that may lead to the formation of cracks in the dentin; use of worn and non - cutting burs which can also cause damage to the pulp [5, 9, 10]. Chemical - mechanical means for removing damaged dentin allow accurate removal of only infected dentin without the involvement of the affected dentin [11]. Preparations based on papaya enzymes are another means of chemical - mechanical excavation [12]. Are they suitable for direct pulp capping?

The present paper aims to investigate direct pulp capping in treating Pulpitis Chronica Ulcerosa Incipiens by removing infected dentin with Brix 3000 (based on the papaya enzyme), the treatment of dentin with gaseous ozone, and Biodentin has been applied as a pulp capping agent.

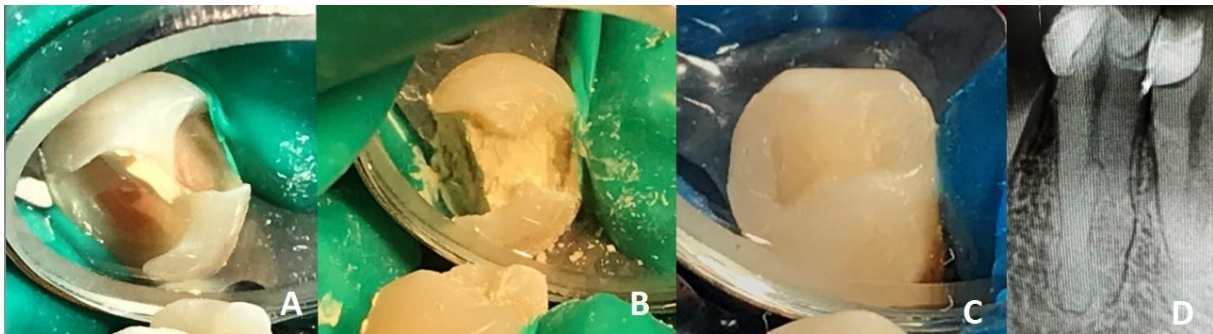
## 2. Material and Methods

Patient PP (39 years old) was diagnosed with Pulpitis chronica ulcerosa incipient of tooth 45. Communication with dental pulp has been established. The condition of the dental pulp was determined by examining the state of nerve sensitivity (Scorpion SM.405.7, Optica laser) and blood circulation in the dental pulp (Contec CMS 8000 pulse oximeter) - EPT 32 $\mu$ A, saturation 89%. An X - ray of the tooth revealed hypotaurodontism in its root canal system with three root canals. Due to the complex anatomy of the root canal system, the initial stage of chronic ulcerative pulpitis, and the appropriate age of the patient, the vital pulp therapy of tooth 45 was planned.



**Figure 1:** X - ray of tooth 45. Hypotaurodontism of the root canal system.

Infected dentin was removed by chemical - mechanical preparation with Brix 3000<sup>[at]</sup>. Place the preparation in the cavity for two minutes. Then carefully scrape the infected dentin with a curette. Several applications and cleaning of infected dentin follow. Transillumination with PROFACE (IDENT, Lausanne, Switzerland) is used to differentiate the infected from the affixed dentin. The affected dentin is colored red. After the infected dentin's complete removal, the communication site with the dental pulp to the vestibular pulp horn is located (Figure 2A). To treat the dentine wound, we rinsed it with saline and treated it with gaseous ozone (ozone generator Prozone (TIP TOP TIPS Sarl, Switzerland) for 24 seconds. We put Biodentine® (Septodont, France) as a base and final restoration of composite resin material (Dimond, Hulzer) (Figure 2B, C).



**Figure 2:** A. Communication with pulp; B. Installation of a Biodentine® (Septodont); C. Final restoration with composite material; D. Dental pulp without periapical changes on X - ray

Paraclinical examinations were performed on days 15, 30, and 45. At day 45, EPT values show 10  $\mu$ A and a saturation of 86%. Figure 2D shows the preserved dental pulp without periapical changes on X - ray. The results months was shown preservation of tooth vitality after six months.

### 3. Discussion

The preservation of the vitality of the dental pulp is essential in complex endodontic anatomy. It is known that treating teeth with taurodontism is difficult since there is a large pulp chamber with an elongated axial size, as in the case we have observed. There are three root canals. Their orifices start from the middle of the tooth root. The literature describes that premolars with taurodontism are similar to molar teeth, with three root canals and fused roots. When opening such a pulp chamber, difficulties in removing pulp tissue and severe bleeding are expected. Due to the atypical location of root canal orifices, further use of the magnifying technique is necessary. This causes difficulties in conducting endodontic treatment [13]. For this reason, direct pulp capping was planned.

The removal of infected dentin by the enzyme papaya also contributed to the success of this treatment. It is known that the preparation acts only on infected dentin, and when it reaches healthy tissue, its action stops - that is, the affected

dentin is not affected by the dentin. Furthermore, communication with the dental pulp is less than 1 mm is favorable for vital pulp therapy [5]. In addition, papain has been shown to have antibacterial action against *Streptococcus mutans* and *Enterococcus faecalis* [14, 15]. *Str. Mutans* is a proven causative agent of dental caries, and Koudhi studies have shown a 55.8% presence of *Enterococcus faecalis* in active caries patients [16].

Floare and co - authors proved that after treatment of the dentin surface with gaseous ozone, the microhardness of the dentin increased, and a remineralization rate between 96.82–97.38% was provided. The authors conclude that gaseous ozone is an alternative to preventing dental caries [17].

Today, published literature confirms that removing infected dentin with papain enzyme is harmless, non - irritating, and non - damaging to healthy tissues in the oral cavity. Brix 3000® successfully removes infected dentin without involving the affected one in the carious lesion. This is fully in line with the modern concept of minimally invasive dentistry. The lack of pain, overheating, vibration, and noise, as the biological and gentle action towards the dental pulp when applying it, make it an indispensable assistant to the dentist in children and adolescents, as well as in adult patients [11, 12].

Treating the dentine wound and pulp communication with gaseous ozone is aimed at destroying microorganisms in the carious hearth. Ozone has also been shown to stimulate dentin factors aimed at tertiary dentin formation and activate growth factors in predentine. This anti-inflammatory effect on the pulp wound creates conditions for forming tertiary dentin and closing the communication opening. It has also been found that applying gaseous ozone to dentin increases its hardness. In deep caries cases, dentin over the pulp is usually thin [18].

The placement of calcium silicate cement Biodentin is the other important factor. The introduction of this type of cement in the dental practice in the last twenty years has established them as an indispensable factor for preserving the vitality of the dental pulp. When Biodentin is applied directly to the pulp, it induces odontoblast differentiation and initial mineralization. A disadvantage of this material can be pointed out by its poor sealing qualities [9, 10]. Some authors have established that the formed dentin bridge is homogeneous and uniformly thick [19]. It is essential that after hardening, Biodentin cement has good bond strength. There was a bond strength of 9.34+1.01 Mpa after 14 days with Biodentine [19]. In this way, direct pulp capping mechanically protects the dental pulp from chewing pressure due to the destruction of the dentin at the site of pulp communication. In adjacent areas, it was significantly thinned.

The preparation based on the enzyme papaya is favorable in direct pulp capping. Combining it with treating the dental wound with gaseous ozone affects the preservation of the vitality of the dental pulp.

#### 4. Conclusion

Within the follow-up of this clinical case, we found that using preparation based on the papain enzyme was conducive to preserving the vitality of the dental pulp under direct pulp capping. We combined it with the treatment of the dentine wound with gaseous ozone with calcium-silicate cement. Further studies are needed along these lines.

#### References

- [1] Galler KM, Weber M, Korkmaz Y, et al. Inflammatory Response Mechanisms of the dentin-pulp complex and periapical tissues. *Int J Mol Sci.*2021; 22: 1480.
- [2] Duncan HF, Galler KM, Tomson PL, et al. European Society of Endodontology position statement: Management of deep caries and the exposed pulp. *Int Endod J.*2019; 52: 923–934.
- [3] Duncan, H. F. Present status and future directions—Vital pulp treatment and pulp preservation strategies. *Int. Endod. J.*2022, 55 (Suppl.3), 497–511.
- [4] Takahiko M, Ayako W, Chiaki K. Current and future options for dental pulp therapy. *Jpn Dent Sci Rev.*2019; 55: 5–11.
- [5] Bjørndal L, Simon S, Tomson PL, Duncan HF. Management of deep caries and the exposed pulp. *Int Endod J.*2019; 52: 949–973.
- [6] AAE Position Statement on Vital Pulp Therapy. *J. Endod.*2021; 47; 1340–1344.

- [7] Kirilova J, Topalova - Pirinska Sn, Kirov D, Deliverska E, Doichinova L. Types of microorganisms in proximal caries lesion and ozone treatment. *Biotechnology & Biotechnological Equipment.*2019; 1: 682 - 688.
- [8] Maltz M, Garcia R, Jardim JJ, et al. Randomized trial of partial vs. stepwise caries removal: 3-year follow-up. *J Dent Res.*2012; 91 (11): 1026 - 1031. doi: 10.1177/0022034512460403
- [9] Hashem D, Mannocci F, Patel S, et al. Clinical and radiographic assessment of the efficacy of calcium silicate indirect pulp capping: a randomized controlled clinical trial. *J Dent Res.*2015; 94 (4): 562 - 568. doi: 10.1177/0022034515571415
- [10] Hashem D, Mannocci F, Patel S, Manoharan A, et al. Evaluation of the efficacy of calcium silicate vs. glass ionomer cement indirect pulp capping and restoration assessment criteria: a randomised controlled clinical trial - 2-year results. *Clin Oral Investig.*2019; 23 (4): 1931 - 1939. doi: 10.1007/s00784 - 018 - 2638 -
- [11] Santos TML, Bresciani E, Matos FS, et al. Comparison between conventional and chemomechanical approaches for the removal of carious dentin: an in vitro study. *Sci Rep.*2020; 10 (1): 8127.
- [12] Kirilova J. Chemical-mechanical removal of infected dentin in caries treatment. *Medinform 2022;* 9 (3); 1566 - 1576. DOI: 10.18044/MedInform.202292.1566
- [13] Kirilova J. Aberrant canal morphology of mandibular premolars - case report. - *International Journal of Scientific Research,* 2014; 10 (3): 83 - 85.
- [14] Juntavee A, J Peerapattana, A Ratanathongkam, et al. The Antibacterial Effects of Apacaries Gel on *Streptococcus mutans*: An in vitro Study. *Int J Clin Pediatr Dent* 2014 May; 7 (2): 77 - 81. doi: 10.5005/jp-journals-10005-1241.
- [15] Silva Júnior, Z. S. *et al.* Papain gel containing methylene blue for simultaneous caries removal and antimicrobial photoinactivation against *Streptococcus mutans* biofilms. *Sci. Rep.*6, 33270;
- [16] Kouidhi B, Zmantar T, Mahdouani K, Hentati H et al. Antibiotic resistance and adhesion properties of oral Enterococci associated to dental caries. *BMC Microbiol* 2011; 11: 155
- [17] Floare AD, Focht D, Hajdu AI, et al. Ozone and microstructural morphological changes of tooth enamel. *Rom J Morphol Embryol.*2022; 63 (3): 539 - 544.
- [18] Al - Omiri MK, Alqahtani NM, Alahmari NM et al. Treatment of symptomatic, deep, almost cariously exposed lesions using ozone. *Sci Rep.*2021; 11 (1): 11166.
- [19] Kunert M, Lukomska - Szymanska M. Bio-Inductive Materials in Direct and Indirect Pulp Capping—A Review Article. *Materials*2020; 13: 1204.

#### Corresponding author:

**Dr. Janet Kirilova, Ph. D.,** Associate Professor, Department of Conservative Dentistry, Faculty of Dental Medicine, Medical University, Sofia; 1, St. Georgi Sofiiski blvd., 1431 Sofia, Bulgaria. Tel: +359 888343396, E-mail: janetkirilova[at]gmail.com